Nomenclature for Computer-assisted Infusion Devices

To the Editor—Computer-assisted infusion devices are open loop control systems that allow the anesthesiologist to select the target blood or plasma concentration or, in some patients, the target effect site concentration likely to be required to achieve a particular pharmacodynamic effect. Depth of anesthesia then is controlled by the anesthesiologist, making adjustments to the target setting as required for each patient.

All such systems require a microprocessor-controlled infusion pump programmed with infusion rate control algorithms linked to a pharmacokinetic simulation program. The program includes a pharmacokinetic model and a specific set of pharmacokinetic parameters for the drug to be infused. Individual academic groups have referred to this technology by a variety of acronyms, including CATIA (computer-assisted total intravenous anesthesia),\(^1\) TIAC (titration of intravenous agents by computer),\(^2\) CACI (computer-assisted continuous infusion),\(^3\) and CCIP (computer-controlled infusion pump).\(^4\) The term, target-controlled infusion (TCI) also has been used in this context.\(^5\) Although TCI covers the concept common to all the previous systems, it avoids implying that a computer rather than an anesthesiologist is controlling the depth of anesthesia. Additionally, commercial TCI systems will not likely require an external computer.

In using and describing any TCI system, there is a need for consistent terminology to identify the drug concentration described, the site at which this concentration is determined, and the pharmacokinetic parameters used in the system. The TCI system should display the target concentration that has been set by the user \((C_T)\) and the concentration that the TCI system calculates will have been achieved \((C_{calc})\). \(C_{calc}\) is preferred to \(C_T\) (predicted concentration) to prevent confusion with \(C_0\) (plasma concentration). In assessing the predictive performance of TCI systems, drug concentrations are measured \((C_0)\) and compared with \(C_{calc}\).\(^6\)

In many cases, the site at which a particular concentration is determined is obvious and always should be mentioned in any article. Where there is a need to specify the site, the previous terminology can be expanded as follows.

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\begin{align*}
C_P &= \text{target plasma concentration}; \\
C_{P0} &= \text{target effect site concentration}; \\
C_P &= \text{measured plasma concentration}; \\
C_P &= \text{calculated plasma concentration}; \text{ and} \\
C_{P0} &= \text{calculated effect-site concentration}. \\
\end{align*}
\]

The time course and magnitude of the pharmacodynamic response achieved at a given \(C_T\) will be influenced by the pharmacokinetic parameters incorporated in the system used.\(^7\) Thus, whenever a target or calculated concentration is given in a manuscript, authors should ensure that they provide information on the pharmacokinetic model and parameter set used. When many models are being used, the use of a second subscript to identify the pharmacokinetic parameter set used would be unambiguous, e.g., \(C_{Pcalc|MATRIS} = \text{calculated plasma concentration based on pharmacokinetic parameters published by MATRIS. et al.}^8\)

In relating pharmacodynamic effects to drug concentrations, \(C_{plasma}\) has been used as the measured plasma concentration \((C_{plasma})\), at which there is a 50% probability of suppressing a response to a certain stimulus.\(^7\) This will continue to be an important index because \(C_{plasma}\) will be independent of the device used. In clinical research and routine clinical experience with TCI systems, wherein information on measured concentrations may not be available, observations based on \(C_{calc}\) displayed by the TCI system when a particular effect is observed may be of more value to a clinician. Ideally, \(C_{plasma}\) or \(C_{calc}\) (with the PK/PD model specified in the text) should be the index used, but \(C_{plasma}\) or \(C_{calc}\) may be suitable alternatives.
with the important proviso that the calculated plasma concentration has been maintained for a sufficient period to permit equilibration with the effect site.

**References**


(Accepted for publication March 26, 1997)

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**The Lower Limit of Autoregulation: Time to Revise Our Thinking?**

*To the Editor*—I am concerned that the popular conception regarding the normal lower limit of cerebral blood flow autoregulation (LLA), frequently identified as 50 mmHg, may be substantially in error. Clinically, one encounters frequent reference to the LLA in discussions regarding minimal acceptable blood pressures for patient management. It has been argued that this relevance has been overemphasized (see below). Nonetheless, the LLA is a widely quoted physiologic limit to which the anesthesiology community, rightly or wrongly, has assigned considerable importance.

Depictions of autoregulation in many standard texts show an autoregulatory plateau between mean arterial pressures of 50 and 150 mmHg. It is likely that the common choice of a mean arterial pressure (MAP) of 50 mmHg as the LLA was significantly influenced by a figure in a review article by Lassen. Lassen's depiction of an LLA of 50 mmHg was in turn an estimate based on data from an investigation by McCall (see table 1) published in 1953. That investigation was performed in pregnant volunteers at or near term, in whom blood pressure was lowered with hydralazine and veratrum viride. The former is a cerebral vasodilator, and the effects of the latter on the cerebral circulation are undefined. Yet, despite of the meager database that identified 50 mmHg as the LLA for healthy humans, the definition has remained widely accepted without thorough confirmation. In part, this may be because the LLA for several animal species is also approximately 50 mmHg. Nonetheless, a review of the literature more recent than McCall's 1953 publication does not confirm that an LLA of 50 mmHg actually prevails in humans. The majority of data derived in healthy, normotensive, nonanesthetized adults argues that the LLA is not less than an average value of 70 mmHg. In

Anesthesiology, V 86, No 6, Jun 1997